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Injuries reflecting intra- and interspecific interactions in the Snake-eyed Skink *Ablepharus kitaibelii* (Bibron & Bory de Saint-Vincent, 1833) (Squamata, Scincidae) from Bulgaria

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Abstract

The Snake-eyed Skink's intra- and inter-specific interactions and their impacts on the individual (e.g. injuries) have received little attention so far. As part of copulation, male lizards bite the females; observations confirm an old report that bites occur in the fore side of the body, along with more recently published information about the back side. Additionally, out of 435 individuals observed *in situ*, 10 had missing extremities (toes, ankles, etc.); however, further studies should identify the causes of such injury, e.g. male-male combat, predators. For the first time, an adult male was observed biting a juvenile *ex situ*; the specific reasons, however, remain unknown. This report should generate further interest in ecological and behavioral studies, assessing the costs and benefits to potential territorial defense, intra-specific combat, and predator pressure and escape mechanisms.

Key Words

aggression, biting, copulation, limb, lizard, tail

Introduction

The Snake-eyed Skink *Ablepharus kitaibelii* (Bibron & Bory de Saint-Vincent, 1833) is a small scincid lizard, with a total length of up to 12 cm for males and 12.8 cm for females in Bulgaria (Stojanov et al. 2011). The species is short-lived (Vergilov et al. 2018), semi-fossorial, with reduced limbs, often utilizing snake-like body undulations for rapid movement (Beshkov and Nanev 2006). It is distributed in Hungary and Slovakia, across the Balkans and Anatolia (Vergilov et al. 2016).

While it is a generally understudied species, several key studies outside Bulgaria have focused on its distribution and taxonomy (e. g. Štepánek 1937, 1944; Mertens 1952; Fuhn 1969, 1970; Schmidtler 1997; Ljubisavljević et al. 2002) and its biology and ecology (Pasuljević 1965, 1966, 1975, 1976; Gruber 1981; Herczeg et al. 2007; Török et al. 2007; Kovács and Kiss 2016).

However, scarce information has been published about its intra- and inter-specific physical interactions and their impacts on individuals. According to Gruber (1981), the species is not territorial. However, Teschler (1885) noted that during the reproductive period males engage in prolonged and exhausting combat that includes opportunistic biting on any body part of the opponent. Further, during the foreplay and copulation males bite the females: Teschler (1885) described during copulation how the biting occurs at the neck, whereas according to Rotter (1962) the male bites the female on the hind side of the body.

Reports of injuries (e.g. caused by predators) or their causes are scarce. Vergilov (2017) published observa-

tions on the defensive behavior of the lizard, where he only noted the general presence of limbless and toeless individuals without providing further details. Although rare, an additional indication of former depredation / aggression might be tail bifurcation. The causes for such bifurcation might be difficult to explain without in-depth case-by-case studies. Generally, they may be the result of errors in the ontogenetic development of an individual: a potential such case for a Bulgarian lacertid is mentioned in Kornilev et al. (2018), whereas Jablonski (2016) described it for the Desert Lidless Skink *A. deserti* Strauh, 1868.

A second tail may also regrow after impartial autotomy or erroneous regrowth following a complete autotomy, resulting from an aggressive encounter (Brock et al. 2014; Dydek and Ekner-Grzyb 2014). For *A. kitaibelii*, bifurcation was first mentioned by Fejérváry (1912); it was quantified for a population by Vergilov and Natchev (2017). Although these publications do not specifically state the causes for bifurcation, most likely they were errors of regeneration.

Following a rare observation of an intra-specific antagonistic behavior, we compiled additional unpublished observations from Bulgaria to provide the first brief overview of physical injuries resulting from intra- and inter-specific interactions in the Snake-eyed Skink.

Methods

We reviewed data obtained from several sources, including *in situ* and *ex situ* observations.

We recorded body injuries in wild-caught individuals, relying on two sources. Between 2013 and 2016, VV carried out an intensive capture-mark-recapture (CMR) study on a population of *A. kitaibelii* from Pastrina Hill, near the town of Montana in north-western Bulgaria (located at cell FP80 from the 10×10 km MGRS/UTM grid; datum: WGS84, GCS). Upon capture, each individual was marked, measured, photographed, and released on the spot (further details presented in Vergilov and Tzankov 2018). Besides field notes, we identified injuries using the photographs taken. Because the original goal of the study was different, injuries were not intentionally sought, thus, likely some (especially minor ones such as missing phalanges) were not detected. Additional field observations on bite marks from copulation were provided by E. Vacheva; these were haphazardly collected from throughout Bulgaria and did not target *A. kitaibelii* specifically.

Furthermore, we made an observation of intra-specific aggression during a laboratory experiment on locomotion performance of *A. kitaibelii* (Vergilov et al., in prep.). In September 2018, we tested thirteen adults and seven juveniles from Bezden Village (UTM cell FN75). All individuals were initially placed in a terrarium (dimensions: 50L×30W×30H cm) with ~3 cm of coconut fiber substrate and oak leaves as hiding place. Within the next 3–4 days individuals that had been filmed were progressively transferred to smaller boxes (dimensions: 18L×18W×8H cm) housing only 2–3 individuals and covered with the same substrate. Animals were kept at ~22 °C; due to the nature of filming, no regular photoperiod could be maintained. Individuals were provided ample small *Tenebrio molitor* L. larvae and water *ad libitum*. In a separate enclosure, single lizards were gently stimulated to move for testing their locomotion performance, while being exposed for 30–40 min to a high-intensity light, necessary for the high-speed filming of the trials.

Results

We present the types of injuries based on their severity and probable frequency of occurrence in nature.

Bite marks

Expectedly, bite marks on female individuals as a result of copulation were observed during the reproductive season (April–May) throughout the country – four individuals from Gabrovitsa, Ihtimanska Sredna Gora Mnt. (UTM cell GM48; pers. comm. E. Vacheva); one from near Ogosta Dam, Montana Town (FP70); and several individuals from Pastrina Hill, near Montana Town.

Males had bitten the females not only on the hind side of the body, but on the fore side as well (two females from Gabrovitsa: Fig. 1B, C).

Although likely to occur in nature as a result of male-male combat, we have not recorded bite marks on male individuals.

Injuries in wild-caught individuals

Overall, out of the 415 marked individuals during the CMR study, 2.17% (n = 9; 3 males, 5 females, 1 juvenile) had missing limbs or toes. When initially captured, only two (an adult female and a juvenile) were detected missing the "ankle" of the left hind limb. In the remaining cases, the injuries were obtained between the capture and a subsequent recapture (average: 386 days, range: 67–742). All such injuries of recaptured individuals were of adults: two females were missing a part of the left hind limb (Fig. 1H, I), two males – phalanges on the left hind limb (Fig. 1F), one male – phalanges on both hind limbs (Fig. 1E), one female – the middle finger on the left hind limb, and one female – the "wrist" on the right fore limb (Fig. 1G).

In addition, among the 20 lizards captured at Bezden, one adult male (described again in the next section) had missing phalanges of the left hind limb and was missing part of the middle finger of the right hind limb (Fig. 1A, D).

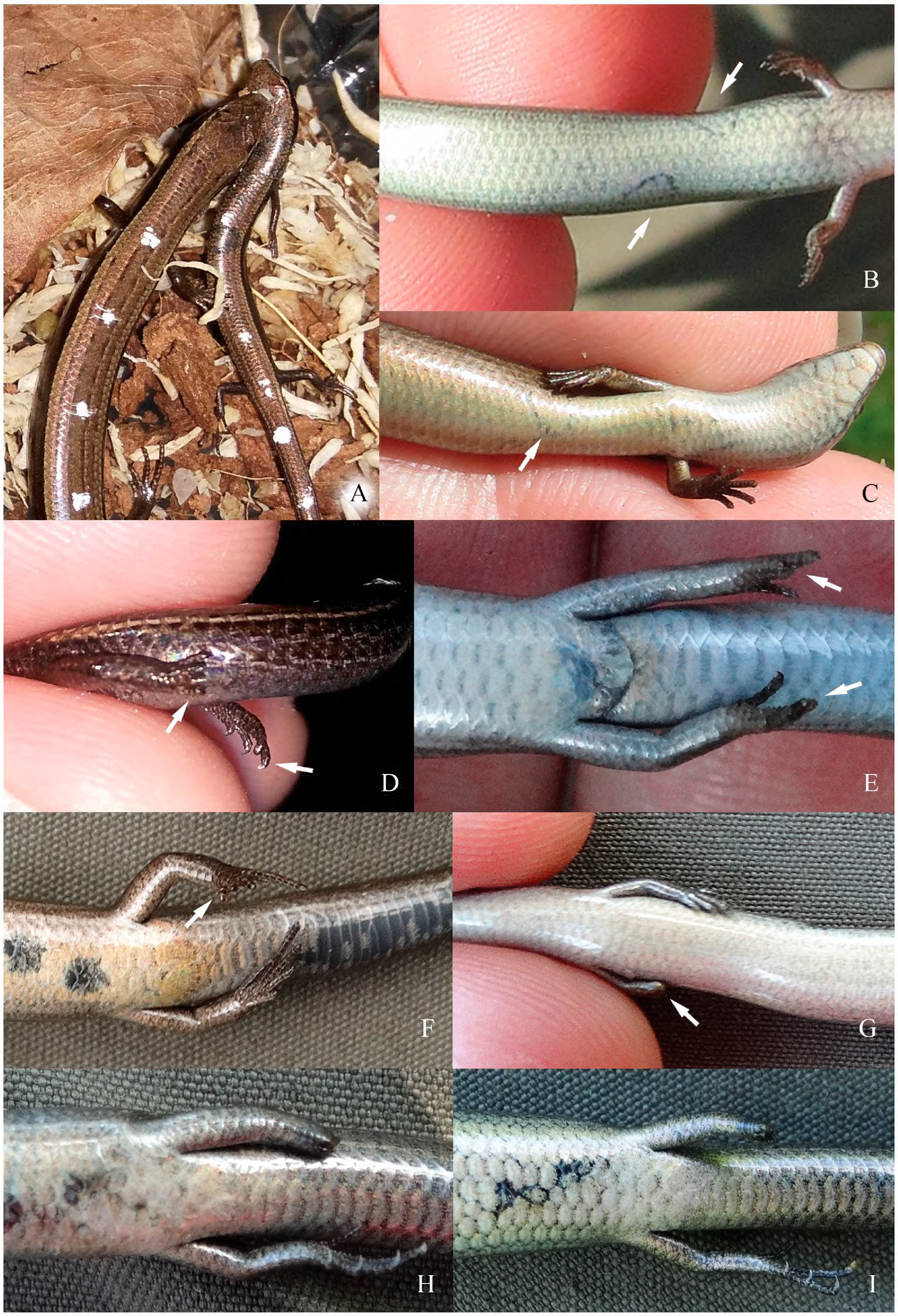

Figure 1. Adult-juvenile aggression (A; white dots are artificial paint-markings), copulation bite marks on females (B, C) and physical injuries (D–I) in *Ablepharus kitaibelii* from Bulgaria. White arrows point to bites or missing extremities.

Intra-specific aggression

During the locomotion experiment, we housed two adults and one juvenile in a smaller container. Approximately two days later, we made a chance observation of an intra-specific aggression. An adult male (Snout-Vent Length, SVL: 4.2 cm, Tail Length, TL: 3.2 cm, regrown; Weight, W: 0.83 g) was biting the juvenile (SVL: 3.0 cm, TL: 3.95 cm, W: 0.29 g) on the head and shaking it (Fig. 1A). For the sake of the experiment, we intervened almost immediately (after taking a few snap photos) and separated the animals; thus, we cannot say what the outcome would have been otherwise. The juvenile had no notable marks or external damage.

Discussion

The Snake-eyed Skink is a small lizard with a secretive life. This makes studying the behavior and intra- and interspecific interactions very difficult. Studies, mostly from 19th to mid-20th century, provide sparse data and observations on behavior (Teschler 1885; Fejérváry 1912; Rotter 1962; Gruber 1981). The only recent study focusing on defensive aspects of the behavior in this species is by Vergilov (2017).

Although there are several publications concerning egg deposition in *A. kitaibelii* (Fuhn 1970; Garbov 1990; Beshkov and Nanev 2006; Valakos et al. 2008; Stojanov et al. 2011; Jovanović Glavaš et al. 2018) and reproduction (see Gruber 1981; Vergilov et al. 2018), the only general observations of the copulation were described by Teschler (1885), Fejérváry (1912) and Rotter (1962). Apparently, for successful copulation males do not have to bite females during the copulation at one specific location and the bite may be on the fore side or hind side of the body. However, prior to this study, only Teschler (1885) had mentioned biting on the fore side. Likely, a precise biting position is not necessary for successful copulation.

Traumas leading to missing extremities are likely caused by either of two sources: intra-specific aggression and depredation. Although Teschler (1885) mentioned prolonged and highly aggressive combat between males, Gruber (1981) reported no signs of territoriality or aggressive defensive behavior. We find it highly possible for injuries to be incurred during such interactions. Natchev et al. (2015) described the feeding of *A. kitaibelii* and observed fast, shaking and twisting motions of the body of the animal to kill the prey. If such aggression is targeted at another Snake-eyed Skink, it is possible that during such movements the biting individual could rip off a toe or part of a limb.

A second source of such traumas are depredation attempts, during which either the predator bit off a piece or the lizard twisted its body violently in an attempt to escape, leading to a loss of an extremity. Such escape behaviors have been reported (Vergilov 2017). As potential predators for *A. kitaibelii* Rotter (1962) mentioned the Green Lizard *Lacerta viridis* (Laurenti, 1768), the Aesculapian Snake *Zamenis longissimus* (Laurenti, 1768), the Smooth Snake *Coronella austriaca* Laurenti, 1768, the Red-backed Shrike *Lanius collurio* Linnaeus, 1758, as well as mammals such as Eulipotyphla and Mustelidae. Gruber and Fuchs (1977) described Erhard's Wall Lizard *Podarcis erhardii* (Bedriaga, 1882) outcompeting and replacing *A. kitaibelii* on some Greek islands by direct predation. *Coronella austriaca* was observed *in situ* in 2018 to consume the tail of a Snake-eyed Skink (near Bezden Village, Bulgaria, FN75; V. Vergilov, B. Zlatkov and A. Herrel). The tail of the Snake-eyed Skink has a very important role for its survival: 59.3% of all caught individuals in Pastrina Hill (n = 415) had missing or regrown tails (Vergilov 2017).

Territorial defense might expose individuals to high predator pressure, and injuries sustained in intra-specific combat could have a high cost on fitness. Future studies should evaluate the costs and benefits of such behaviors for *A. kitaibelii*, the extent of their occurrence in nature, and the impacts of predators.

Regarding the intra-specific interaction we observed, we can only stipulate potential causes. A specific stressful situation leading to this behavior is unlikely; instead it might be a result of repetitive stress. Still, overall, animals did not seem to be abnormally stressed. Although some animals exhibited rapid escape movements (indicative of stress) especially at the beginning of the locomotion experiment, generally they seemed to habituate rapidly, evidenced by their propensity to predominantly utilize slow to very slow escape movements. Individuals also readily fed in between filming attempts, both indicative of habituation and decreasing the probability that the aggression was caused by hunger. Furthermore, we have not found reports on cannibalism. Although individuals can bite as a defensive behavior (Vergilov 2017), this seems unlikely given the size discrepancy between the two individuals. We hypothesize that this aggression is an atypical behavior in *A. kitaibelii*.

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